§12. Fast Changes in Central Electron Temperature in CHS

Duorah, S.[1], Ejiri, A.[2], Takase ,Y.[2], Lee, S.[3], Iguchi, H., Matsuoka, K., CHS Group
[1] Dep. of Physics, Univ. of Tokyo
[2] Dep. of Complexity Science, Univ. of Tokyo
[3] JAERI

A 20 channel fully calibrated [1] MLM based soft X-ray spectrometer was installed on CHS for central electron temperature measurement. The high throughput of the MLM and the fast time response of the PIN diode detector array made it possible to make continuous and fast (0.1 ms) measurement of soft x-ray spectrum. If the radiation does not contain recombination edges and/or line radiation, the slope of the soft X-ray spectrum gives us the electron temperature.

As the reflectivity of the MLM and the electron-hole pair production efficiency of the PIN diode detectors depend on the photon energy, they were calibrated at KEK, Tsukuba. The energy range was from 300 eV to 1200 eV. The efficiency of the PIN diodes was found to be 100% in this energy range. For the calibration of the MLM, light with a high degree of linear polarization was used. Therefore, the measured reflectivity was done only for the s-wave. So, to calculate the total reflectivity for a randomly polarized radiation emitted by the plasma, it was necessary to know 1) the number of layers of the MLM, 2) the period and 3) the ratio of the thickness of the reflecting layer to the period of the MLM. The values determined from the best fit with the measured reflectivity were found to be N ~ 200, ratio = 0.6. The comparison between the measured values of the reflectivity and the theoretically calculated values is shown in Fig.1. The manufacturer's specification for the period d was 2d = 67.4 ± 14 Å which was consistent with the value of 2d = 67.6 Å derived from the measured reflectivity.

Figure 2 shows the electron temperature (T_e) determined from the slope of the spectrum. The derived T_e was much lower than those obtained from a Thomson Scattering system. Analysis of the observed spectrum showed that the factor by which the observed radiation exceeds the bremsstrahlung radiation was between 50 - 1000.[2] It is thus concluded that the observed spectrum is highly contaminated by the presence of impurity radiation and the slope of the spectrum does not represent the electron temperature.

Although the electron temperature can not be measured with the present setup, it is possible to measure the spectrum with a high time resolution of 0.1 ms. During MHD bursts, modulations in the soft X-ray intensity were observed. However, no large modulations in the slope of the spectrum was observed. The maximum amplitude of the modulation was found to be around 20%. A modulation in the density of order of 10 % can account for the observed soft X-ray modulation. No modulations were observed either by the Thomson scattering diagnostic or in the line averaged density measured by the HCN laser interferometer. Thus, the major cause of the modulation in the soft X-ray intensity seems to be due to modulations in the temperature and/or in the impurity density. Further changes are being planned to study this phenomena in details.

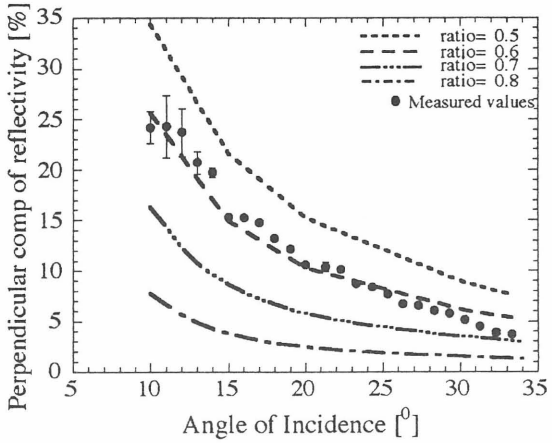

Fig.1. Comparison of the measured and theoretically calculated values of the reflectivity with N ~ 200, 2d = 67.6 Å

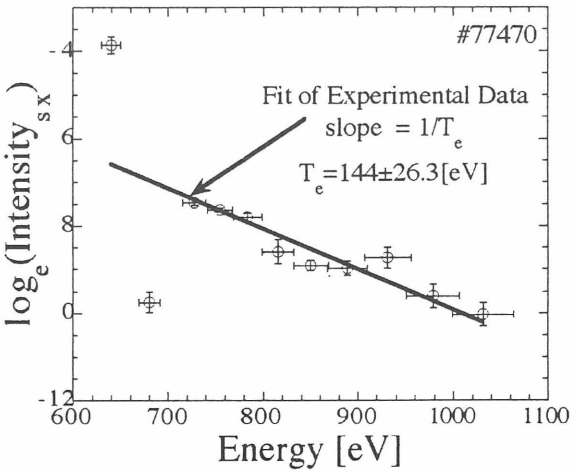

Fig.2. Soft X-ray spectrum and fit for determination of the electron temperature

References

1) Ishiyama. E. Master Thesis. Univ. of Tokyo (1996)
2) Duorah. S., Doctoral Thesis, University of Tokyo , March. 2000.